Response to Final Office Action Mailed January 15, 2003

A. Pending Claims

Claims 1608-1611, 1613-1650, 1652-1685, 5396-5400, and 5402-5412 are pending in the case. Claims 1608, 1609, 1616, 1617, 1619, 1631, 1641, 1642, 1645-1648, 1654, 1656, 1658, 1670, 1673, 1680, 1681, 1684, 1685, 5400, 5402, 5404, 5406, 5407, and 5412 have been amended. The claims have been amended for clarification and/or for correction of typographical errors. Claims 1612, 1651, and 5401 have been cancelled.

B. Provisional Double Patenting Rejection

The Examiner provisionally rejected claims 1608-1685 and 5396-5412 under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims of copending U.S. Patent Application Nos.:

09/840,936; 09/840,937; 09/841,000; 09/841,060; 09/841,061; 09/841,127; 09/841,128; 09/841,129; 09/841,130; 09/841,131; 09/841,170; 09/841,193; 09/841,194; 09/841,195; 09/841,238; 09/841,239; 09/841,240; 09/841,283; 09/841,284; 09/841,285; 09/841,286; 09/841,287; 09/841,288; 09/841,289; 09/841,290; 09/841,291; 09/841,292; 09/841,293; 09/841,294; 09/841,295; 09/841,296; 09/841,297; 09/841,298; 09/841,299; 09/841,300; 09/841,302; 09/841,303; 09/841,304; 09/841,305; 09/841,306; 09/841,307; 09/841,308; 09/841,309; 09/841,310; 09/841,311; 09/841,312; 09/841,429; 09/841,430; 09/841,431; 09/841,432; 09/841,433; 09/841,434; 09/841,435; 09/841,436; 09/841,437; 09/841,438; 09/841,439; 09/841,440; 09/841,441; 09/841,442; 09/841,443; 09/841,444; 09/841,445; 09/841,446; 09/841,447; 09/841,448; 09/841,449; 09/841,488; 09/841,489; 09/841,490; 09/841,491; 09/841,492; 09/841,493; 09/841,494; 09/841,495; 09/841,496; 09/841,497; 09/841,498; 09/841,499; 09/841,500; 09/841,501; 09/841,502; 09/841,632; 09/841,633; 09/841,634; 09/841,635; 09/841,636; 09/841,637; 09/841,638; and 09/841,639.

Applicant respectfully traverses the provisional double patenting rejection. Applicant respectfully submits that the omnibus nature of this rejection does not provide Applicant with sufficient detail in which to address such rejection. Applicant also respectfully submits that the rejection is inconsistent with certain restrictions issued in the above-referenced cases. Applicant

respectfully requests reconsideration.

Pursuant to discussion with the Examiner, for the convenience of the Examiner's Supervisor, Applicant will forward copies of allowed claims for the above-referenced cases to the Examiner's Supervisor. Applicant understands that the Examiner's Supervisor will review the allowed claims for the above-referenced cases and then reconsider the double patenting rejection in view of such allowed claims.

C. Claim Objections

The Examiner objected to claim 5412 because of the following informalities: it was questioned whether "heat sources" should be "heaters". Claim 5412 has been amended for clarification.

D. The Claims Are Not Anticipated By Tsai et al. Pursuant To 35 U.S.C. § 102(b)

The Examiner rejected claims 1608, 1610, 1613, 1614, 1618, 1634, 1641-1643, 1647, 1649, 1652, 1653, 1657, 1673, 1680-1682, 5398, 5399, 5400, 5401, 5403, 5404, and 5408 under 35 U.S.C. 102(b) as anticipated by U.S. Patent No. 4,299,285 to Tsai et al. (hereinafter "Tsai"). Applicant respectfully disagrees with these rejections.

The standard for "anticipation" is one of fairly strict identity. To anticipate a claim of a patent, a single prior source must contain all the claimed essential elements. *Hybritech, Inc. v. Monoclonal Antibodies, Inc.*, 802 F.2d 1367, 231 U.S.P.Q.81, 91 (Fed.Cir. 1986); *In re Donahue*, 766 F.2d 531, 226 U.S.P.Q. 619, 621 (Fed.Cir. 1985).

The Examiner states:

> With regards to independent claims 1608 and 1647; applicant has argued that the Tsai reference fails to teach or suggest 'providing heat from

one or more heaters to at least a protion of the formation'. Applicant also provides text from the specification to support a definition of 'heater', which would exclude the fire taught by Tsai.

It is noted that applicant's specification also includes much broader definitions of 'heater', which include fire.

The Examiner quotes from page 3, lines 20-28 of the Specification. Applicant respectfully disagrees with the Examiner's characterization of the Applicant's Specification. The portion of the Applicant's Specification which the Examiner cited is under the section "Description of Related Art". The description of related art describes to the extent practical the state of the prior art or other information disclosed known to the applicant. MPEP 608.01(c). The description of a heater cited from page 40 of the Applicant's Specification is from the Specification section titled "Detailed Description of the Invention". An applicant may be his or her own lexicographer. *In re Hill*, 161 F.2d 367, 73 U.S.P.Q. 482 (C.C.P.A. 1947); MPEP 2111.01. Applicant submits that a "heater" has been described at least on page 40 of the Applicant's Specification, and the Examiner has stated that this definition excludes the method taught by Tsai.

The Examiner states: "The Tsai reference teaches a method for treating a coal formation in situ comprising providing heat from one or more heaters to a portion of the formation; allowing the heat to transfer, and producing a mixture as called for in claim[s] 1608 [1647, 5400]. Although the Tsai reference fails to explicitly disclose the atomic hydrogen weight percentage greater than about 4%; this is inherent feature of bituminous coal (bituminous coal is taught in col. 1, line 7 of Tsai et al.) as shown in table 2.5 and figure 2.9 of 'Coalbed Methane'."

The fact that a certain result or characteristic may occur or be present in the prior art is not sufficient to establish the inherency of that result or characteristic. *In re Rijckaert*, 9 F.3d 1531, 1534, 28 USPQ2d 1955, 1957 (Fed. Cir. 1993). "To establish inherency, the extrinsic evidence 'must make clear that the missing descriptive matter is necessarily present in the thing described in the reference, and that it would be so recognized by persons of ordinary skill. Inherency, however, may not be established by probabilities or possibilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient.'" *In re Robertson*,

169 F.3d 743, 745, 49 USPQ2d 1949, 1950-51 (Fed. Cir. 1999). In relying upon the theory of inherency, the Examiner must provide a basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic necessarily flows from the teachings of the applied prior art. *Ex parte Levy,* 17 USPQ2d 1461, 1464 (Bd. Pat. App. & Inter. 1990). Applicant respectfully requests that the Examiner provide support that a hydrogen weight percentage of greater than about 4.0% is inherent to Tsai.

Tsai discloses: "the oxidizing gas is injected into the injection hole at an appropriate rate and the fire is started in the coal bed at the injection well." (Tsai, col.2, lines 30-33) Amended claims 1608, 1467, and 5400 describe a combination of features including: "providing heat from one or more heaters positioned in heater wells to at least a portion of the formation". Support for amendments to the claims is found in the Specification at least on page 40, lines 6-8. Tsai does not appear to teach or suggest at least the above-quoted feature.

For at least the reasons described above, Applicant requests that the rejection of claims 1608, 1647, 5400, and claims dependent thereon be removed. Furthermore, Applicant submits that many of the claims dependent on claims 1608, 1647, and 5400 are separately patentable.

The Examiner states: "With regards to claim 1610 [1649, 5403]; the Tsai reference reaches a pyrolysis temperature range within a section of the formation (see col. 4, line 54)." Tsai states: "In general, we prefer that the temperature of the heated air be a maximum of about 350 °C. and most prefer that the maximum temperature be about 300 °C. The range of about 150 °C to about 300 °C is a particularly suitable operating range." (Tsai, col. 3, lines 41-45)

Claims 1610 and 1649 describe a combination of features including: "maintaining a temperature within the part of the formation within a pyrolysis temperature range of about 270 °C to about 400 °C." Claim 5403 describes a combination of features including: "maintaining a temperature within the selected section of the formation within a pyrolysis temperature range of about 270 °C to about 400 °C." Applicant submits that Tsai appears to teach a temperature of heated air to be injected into the formation. Tsai does not appear to teach or suggest maintaining

a temperature within a part of the formation within a pyrolysis temperature range. Applicant submits at least the above-quoted features of the claims, in combination with other features of the claims, do not appear to be taught or suggested by the cited art. Applicant respectfully request removal of the rejections of claims 1610, 1649, and 5403.

The Examiner states: "With regards to claim 1613 [1652]; the Tsai reference teaches a flameless combustor (see col. 2, line 32)." The Examiner further states: "With regards to claim 1614 [1653, 5404]; the Tsai reference teaches a natural distributed combustor (see col. 2, line 32)." Tsai states: "the oxidizing gas is injected into the injection hole at an appropriate rate and the fire is started in the coal bed at the injection well." (Tsai, col. 2, lines 31-34)

In reference to flameless combustion, Applicant's Specification discloses:

> Flameless combustion may be accomplished by preheating a fuel and combustion air to a temperature above an auto-ignition temperature of the mixture. The fuel and combustion air may be mixed in a heating zone to combust. In the heating zone of the flameless combustor, a catalytic surface may be provided to lower the auto-ignition temperature of the fuel and air mixture. (Specification, p. 4, lines 2-6)

Applicant's specification also discloses:

> FIG. 28 illustrates an embodiment of a flameless combustor configured to heat a section of the hydrocarbon containing formation. (Specification, p. 119, lines 7-8)
>
> Oxidation of fuel fluid 621 may provide heat generation within outer conduit 636. The generated heat may provide heat to at least a portion of a hydrocarbon containing formation proximate to the oxidation region of inner conduit 638. Products 625 from oxidation of fuel fluid 621 may be removed through outer conduit 636 outside inner conduit 638. (Specification, p. 119, line 28 – p. 120, line 2)

In reference to a natural distributed combustor, Applicant's Specification discloses:

> As used herein, the phrase "natural distributed combustor" generally refers to a heater that uses an oxidant to oxidize at least a portion of the carbon in the formation to generate heat, and wherein the oxidation takes place in a vicinity proximate to a wellbore. Most of the combustion products produced in the natural distributed combustor are removed through the wellbore. (Specification, p. 40, lines 19-24)
>
> Although the heat from the oxidation is transferred to the formation, oxidation product 519 (and excess oxidation fluid such as air) may be substantially inhibited from flowing through the formation and/or to a production well within formation 516. Instead oxidation product 519 (and excess oxidation fluid) is removed (e.g., through a conduit such as conduit 512) as is described herein. In this manner, heat is transferred to the formation from the oxidation but exposure of the pyrolysis zone with oxidation product 519 and/or oxidation fluid may be substantially inhibited and/or prevented. (Specification, p. 77, lines 18-24)

Claims 1613 and 1652 describe features including: "wherein at least one of the one or more heaters comprises a flameless distributed combustor." Claims 1614, 1653, and 5404 describe features including: "wherein at least one of the one or more heaters comprises a natural distributed combustor." Tsai does not appear to teach or suggest a heater such as a natural distributed combustor or a flameless combustor. Tsai appears to teach or suggest starting a fire in the coal bed. Applicant submits that the flameless distributed combustor of claims 1613 and 1652 and the natural distributed combustor of claims 1614, 1653, and 5404 are not taught or suggested by Tsai. Applicant respectfully request removal of the rejections of claims 1613, 1614, 1652, 1653, and 5404.

The Examiner states: "With regards to claim 1634 [1673, 5408], the Tsai reference teaches the pressure greater than 2.0 bar." Tsai states: "Air is heated to a temperature of about 250 °C and is injected into the injection well at a pressure of approximately 500 psi.... Combustion air at ambient temperature is now injected into the injection hole at a pressure of 50 psi...." (Tsai, col. 7, line 62-col. 8, line 11) Tsai appears to teach a pressure of air injected into a formation.

Claims1634 and 5408 and amended claim 1673 describe a combination of features including: "controlling a pressure within at least a majority of the part of the formation, wherein the controlled pressure is at least about 2.0 bar absolute." Applicant submits that Tsai does not appear to teach or suggest controlling a pressure within a formation or within at least a majority of a part of a formation. At least the above-quoted features of the claims, in combination with other features of the claims, do not appear to be taught or suggested by the cited art. Applicant respectfully requests removal of the rejections of claims 1634, 1673, and 5408.

The Examiner states: "With regards to claims 1641 [1680] and 1642 [1681]; the Tsai reference teaches the permeability greater than about 100 md in table 1. The uniform increase in permeability is inherent." Contrary to the Examiner's statement that "applicant has failed to provide any evidence that the uniform increase of permeability is not inherent," Applicant submits that, in relying upon the theory of inherency, the Examiner must provide a basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic necessarily flows from the teachings of the applied prior art. In some situations, heating caused by a fire flood may increase permeability in local areas through which the fire flood has passed, but such heating will not result in an uniform increase in permeability.

Amended claims 1641 and 1680 describe a combination of features including: "wherein allowing the heat to transfer increases a permeability of a majority of the part of the formation to greater than about 250 millidarcy." Support for amendments to the claims is found in the Specification as follows:

> Permeability of a selected section within the heated portion of the hydrocarbon containing formation may also rapidly increase while the selected section is heated by conduction. For example, permeability of an impermeable hydrocarbon containing formation may be less than about 0.1 millidarcy (9.9 x 10^{-17} m^2) before treatment. In some embodiments, pyrolyzing at least a portion of a hydrocarbon containing formation may increase a permeability within a selected section of the portion to greater than about 10 millidarcy, 100 millidarcy, 1 Darcy, 10 Darcy, 20 Darcy, or 50 Darcy. Therefore, a permeability of a selected section of the portion may increase by a factor of

more than about 1,000, 10,000, or 100,000. (Specification, page 151, line 28-page 152, line 5)

Amended claims 1642 and 1681 describe a combination of features including: "wherein allowing the heat to transfer increases a permeability of a majority of the part of the formation such that the permeability of the majority of the part is substantially uniform."

Permeabilities recorded in Table I of Tsai do not appear to be substantially uniform. Tsai states: "The initial permeability of the core was 2.0, after two days it was 27.5, after three days it was 77.2 and after four days it was 107 as reported in Table I." (Tsai, col. 7, lines 11-14) In addition, Table I of Tsai discloses a permeability of 107 md for Ex. 6 and a permeability of 148 md for Ex. 7, in which the axis of the core was perpendicular to the bedding plane. Tsai also states: "It should be appreciated that the coal, following the pretreatment and conditioning procedure, will exhibit a zone of increasing free swelling index and a decreasing permeability in a direction away from the fracture-induced linkage until non-affected coal is reached." (Tsai, col. 5, lines 32-37) Tsai does not appear to teach or suggest at least the above-quoted features of claims 1642 and 1681. Applicant submits at least the above-quoted features of claims 1642 and 1681, in combination with other features of the claims, do not appear to be taught or suggested by the cited art. Applicant respectfully requests removal of the rejection of claims 1642 and 1681.

The Examiner states: "With regards to claim 1643 [1682], although the Tsai reference fails to explicitly disclose a Fischer Assay; it is apparent that the disclosed process will yield greater than 60%." In relying upon the theory of inherency, the Examiner must provide a basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic necessarily flows from the teachings of the applied prior art.

Claims 1643 and 1682 describe a combination of features including: "further comprising controlling the heat to yield greater than about 60 % by weight of condensable hydrocarbons, as measured by the Fischer Assay." Applicant does not understand the Examiner's statement that

"applicant has not shown any evidence that the volatile content of coal is the same as the yield. Note that since the volatile content is reported along with ash content, it clearly cannot be equated to yield." Applicant submits at least the above-quoted features of claims 1643 and 1682, in combination with other features of the claims, do not appear to be taught or suggested by the cited art. Applicant respectfully requests removal of the rejection of claims 1643 and 1682.

The Examiner states: "With regards to claim 5398 [5399]; Tsai teaches the pyrolysis zone." Tsai states: "Initially, there is a vaporization of moisture from the coal and a loss of some volatile carbonaceous material. Some of this may be the result of a minor pyrolysis of the coal." (Tsai, col. 4, lines 51-54) Claims 5398 and 5399 describe a combination of features including: "wherein the part of the formation comprises a pyrolysis zone." Tsai does not appear to teach or suggest a zone in which pyrolysis occurs in the formation. Applicant submits at least the above-quoted features of claims 5398 and 5399, in combination with other features of the claims, do not appear to be taught or suggested by the cited art. Applicant respectfully requests removal of the rejection of claims 5398 and 5399.

E. The Claims Are Not Obvious Over Tsai Pursuant To 35 U.S.C. § 103(a)

The Examiner rejected claims 1609, 1611, 1612, 1619-1631, 1635, 1636, 1648, 1650, 1651, 1658-1670, 1674, 1675, 5402, 5409, and 5410 under 35 U.S.C. 103(a) as obvious over Tsai. Applicant respectfully disagrees with these rejections.

In order to reject a claim as obvious, the Examiner has the burden of establishing a *prima facie* case of obviousness. *In re Warner et al.*, 379 F.2d 1011, 154 U.S.P.Q. 173, 177-178 (C.C.P.A. 1967). To establish a *prima facie* obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art. *In re Royka*, 490 F.2d 981, 180 U.S.P.Q. 580 (C.C.P.A. 1974), MPEP § 2143.03.

If an independent claim is nonobvious under 35 U.S.C. § 103, then any claim depending therefrom is nonobvious. *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988). For at

least the reasons cited in Section D, independent claims 1608, 1647, and 5400 are not obvious over the cited art. Applicant therefore request removal of the rejection of claims dependent thereon. Applicant further submits that claims dependent on claims 1608, 1647, and 5400 may be separately patentable.

The Examiner states: "With specific regards to claims 1619 and 1658; the Tsai reference does not teach the thermal conductivity; however, it would have been further obvious to one of ordinary skill in the art at the time of the invention to have practiced the Tsai method in a coal seam having a thermal conductivity of greater than about 0.5W(m°C) as called for in claims 1619 and 1658; such a formation would be a desirable choice because it would heat more uniformly." The Examiner also provided a reference which shows a range of thermal conductivities in coal including the value of 0.5W(m°C).

Claims 1619 and 1658 have been amended to describe a combination of features including: "wherein allowing the heat to transfer to the part of the formation heats the part of the formation to increase a thermal conductivity of at least a portion of the part of the formation to greater than about 0.5 W/(m °C)." Support for this amendment is found at least on page 22 (lines 18-20) of the Specification. Applicant submits that heating a part of a formation to increase a thermal conductivity of at least a portion of the part of the formation to greater than about 0.5 W/(m °C) is not shown by a combination of Tsai and the reference supplied by the Examiner. Applicant respectfully requests removal of the rejection of claims 1619 and 1658.

The Examiner states: "With regards to claims 1620-1631, 1635, 1636, 1658-1670, 1674, 1675, 5409, and 5410; the nature of hydrocarbons produced from such heating is highly variable, and dependent upon many factors, not least of which is the characteristics of the coal. The components of the produced mixture are deemed to be the results of design variables, including coal characteristics and temperature."

Tsai states:

> Upon heating a swellable bituminous coal without combustion, it will soften, as stated, at a rather well defined temperature, designated its softening temperature behaving like a plastic material within a plastic temperature range. Pyrolysis of the softened coal and the formation of bubbles within the plastic mass causes the swelling of the coal. Continued pyrolysis for a period of time causes a resolidification of the coal at a greater volume than the original coal. This softening, expansion and resolidification, as briefly mentioned herein, is the process by which the air channels or links in swellable coal are blocked at the high temperatures involved during in situ gasification. (Tsai, col. 4, lines 14-26)

Tsai further states: "The net result is a combustible product gas comprising carbon monoxide, hydrogen and some methane as its principal combustibles and having a heat content which depends on many factors including whether supplemental oxygen and/or water are added to the oxidizing gas." (Tsai, col. 5, line 55 – col. 6, line 1)

Applicant's specification states:

> One or more heat sources may be used to heat a portion of the hydrocarbon containing formation to temperatures that allow pyrolysis of the hydrocarbons. Hydrocarbons, hydrogen, and other formation fluids may be removed from the formation through one or more production wells. The formation fluids may be removed in a vapor phase. Temperature and pressure in at least a portion of the formation may be controlled during pyrolysis to yield improved products from the formation. (Specification, p. 10, lines 6-11)

Applicant submits that the product mixtures recited in claims 1620-1631, 1635, 1636, 1658-1670, 1674, 1675, 5409, and 5410 would not be producible by carrying out the in situ combustion process of Tsai. The product mixtures recited in claims 1620-1631, 1635, 1636, 1658-1670, 1674, 1675, 5409, and 5410 may be produced by controlling and/or modifying formation conditions during treatment to produce the selected results recited in the claims. Applicant respectfully requests removal of the rejection of claims 1620-1631, 1635, 1636, 1658-1670, 1674, 1675, 5409, and 5410.

F. The Claims Are Not Obvious Over Tsai In View of Kasevich Pursuant To 35 U.S.C. § 103(a)

The Examiner rejected claims 1616, 1617, 1655, 1656, 5406, and 5407 under 35 U.S.C. 103(a) as obvious over U.S. Patent No. 4,299,285 to Tsai et al. in view of U.S. Patent No. 4,457,365 to Kasevich et al. (hereinafter "Kasevich"). Applicant respectfully disagrees with these rejections.

The Examiner states: "since the increase of temperature stops, the heating must inherently comprise a rate of increase less than than 1.6°C." Kasevich states: "Thus, if the kerogen were heated from 150 °C. to 500 °C. at the rate of 50 °C./month, the absorption rate would approximate that of curve 114 [in Figure 3], while more rapid heating rates would produce curves 120, 122 and 124 for heating rates of 50 °C. per month, 50 °C./day, 50 °C./hour and 50 °C./minute, respectively" (Kasevich, col. 8, lines 57-62).

Figure 3 of Kasevich shows a heating rate of 50 °C/month, which may correspond to an average heating rate of about 1.6 °C/day. Kasevich, however, does not appear to teach or suggest the features of amended claims 1616, 1655, and 5406 including: "controlling the heat such that an average heating rate of the part of the formation is less than about 1 °C per day in a pyrolysis temperature range of about 270 °C to about 400 °C." Support for the pyrolysis temperature range in claims 1616, 1655, and 5406 may be found at least on page 46 (lines 15 and 16) of the Specification. At least the above-quoted features of claims 1616, 1655, and 5406, in combination with other features of the claims, do not appear to be taught or suggested by a combination of the cited art. Applicant respectfully requests removal of the rejection of claims 1616, 1655, and 5406.

The Examiner states:

> With regards to claims 1617, 1656, and 5406; it is known to heat at rates of less than 10°C per day, as shown by Kasevich (figure 3). It is apparent that this low

heating rate is desirable because it results in more uniform heating, and reduces the possibility of hot spots. It would have been obvious to one of ordinary skill in the art at the time of the invention to have modified the Tsai method to have included heating at a rate of less than about 10°C per day as called for in claims 1617, 1656, and 5406 in order to achieve more uniform heating. The claim limitations drawn to the heating energy are nothing more than well known thermodynamic equations.

The Examiner further states: "the claims do not call for 'using a desired heating rate to calculate a maximum amount of heating'." Applicant respectfully disagrees with the Examiner's characterization of claims 1617, 1656, and 5406. Amended claims 1617, 1656, and 5407 describe a combination of features including: "wherein heating energy/day (*Pwr*) provided to the selected volume is equal to or less than $h*V*C_v*\rho_B$, wherein ρ_B is formation bulk density, and wherein an average heating rate (h) of the selected volume is about 10 °C/day." The claims describe heating energy/day (*Pwr*) provided to the selected volume. The heating energy/day (*Pwr*) provided to the selected volume is equal to or less than a product of the average heating rate, the selected volume, the average heat capacity of the formation, and the formation bulk density. For a selected volume of a formation, the average heating energy/day required to achieve desired average heating rate (in this case about 10 °C/day) may be calculated and applied to the selected volume. The calculated average heating energy/day will be the maximum average heating energy/day that may be applied to the formation without exceeding the desired average heating rate. Applicant respectfully maintains that the combination of Tsai and Kasevich do not appear to teach or suggest using a desired heating rate to calculate a maximum average heating energy/day to be applied to a selected volume of a formation. Applicant respectfully requests removal of the rejection of claims 1617, 1656, and 5407.

G. The Claims Are Not Obvious Over Tsai In View of Gregoli Pursuant To 35 U.S.C. § 103(a)

The Examiner rejected claims 1637-1640 and 1676-1679 under 35 U.S.C. 103(a) as obvious over Tsai in view of U.S. Patent No. 6,016,867 to Gregoli et al. ("Gregoli"). Applicant respectfully disagrees with these rejections.

The Examiner states:

> The Tsai reference fails to teach the recirculating hydrogen, providing hydrogen, or hydrogenating. The Gregoli reference teaches that in a similar in-situ processes, it is beneficial to use hydrogen to hydrogenate heavy hydrocarbons.... It would have been obvious to one of ordinary skill in the art at the time of the invention to have modified the Tsai method to have included recirculating hydrogen as called for in claim 1638; providing hydrogen as called for in claim 1639; and hydrogenating as called for in claim 1640; in order to reduce the heavy hydrocarbons and to improve production.

Figure 1 of Gregoli depicts injection of hydrogen into the reservoir by way of the injection-well borehole. Gregoli does not appear to teach or suggest features of claims 1638 and 1677 including: "controlling formation conditions by recirculating a portion of hydrogen from the mixture into the formation." Gregoli does not appear to teach or suggest features of claims 1640 and 1679 including: "producing hydrogen and condensable hydrocarbons from the formation; and hydrogenating a portion of the produced condensable hydrocarbons with at least a portion of the produced hydrogen." Applicant submits that the Examiner is extending the teaching of Gregoli in the obviousness rejection of claims 1638, 1640, 1677, and 1679. Applicant respectfully requests removal of the rejection of claims 1638, 1640, 1677, and 1679.

Gregoli appears to use superheated steam and hot hydrogen to heat heavy hydrocarbons in a reservoir. Gregoli does not appear to teach or suggest features of claims 1639 and 1678 including: "heating a portion of the part of the formation with heat from hydrogenation." Applicant submits that the Examiner is extending the teaching of Gregoli in the obviousness rejection of claims 1639 and 1678. Applicant respectfully requests removal of the rejection of claims 1639 and 1678.

H. The Claims Are Not Obvious Over Tsai In View of Van Meurs Pursuant To 35 U.S.C. § 103(a)

The Examiner rejected claims 1644, 1645, 1683, 1684, 5396, 5397, 5411, and 5412 under 35 U.S.C. 103(a) as obvious over Tsai in view of U.S. Patent No. 4,886,118 to Van Meurs et al. (hereinafter "Van Meurs"). Applicant respectfully disagrees with these rejections.

Van Meurs states:

> Even with respect to a five-spot pattern in which a single fluid-producing well is surrounded by four heat-injecting wells, substantially all of the intervening oil shale can be both retorted and made permeable. However, the present invention is preferably employed in a series of contiguous seven—or thirteen-spot patterns—in either of which patterns (particularly in the thirteen-spot pattern) and retorting rate is significantly increased by having each fluid producing well surrounded by six or twelve heat-injecting wells.

Van Meurs appears to teach three discrete patterns for heat-injecting wells. Van Meurs does not appear to teach or suggest a range of heaters for each production well. In particular, Van Meurs does not appear to teach or suggest features of claims 5396 and 5397 and amended claim 5412 including: "wherein at least about 20 heaters are disposed in the formation for each production well." Applicant submits that the Examiner is extending the teaching of Van Meurs in the obviousness rejection of claims 5396 and 5397. Applicant respectfully requests removal of the rejection of claims 5396 and 5397.

I. Summary

Applicant submits that all claims are in condition for allowance. Favorable consideration is respectfully requested.

It is believed that no fees are due in association with the filing of this and accompanying documents. If any extension of time is required, Applicant hereby requests the appropriate

extension of time. If any fees are required, please charge those fees to Meyertons, Hood, Kivlin, Kowert & Goetzel, P.C. Deposit Account Number 50-1505/5659-01800/EBM.

Respectfully submitted,

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Date: MARCH 19, 2003

Marked-Up Version of Amendments Submitted With Amendment; Response to Final Office Action Mailed January 15, 2003

In the Claims:

1608. (amended) A method of treating a hydrocarbon containing formation in situ, comprising:

providing heat from one or more heaters positioned in heater wells to at least a portion of the formation;

allowing the heat to transfer from one or more of the heaters to a part of the formation;

wherein the part of the formation has been selected for heating using an atomic hydrogen weight percentage of at least a portion of hydrocarbons in the part of the formation, and wherein at least the portion of the hydrocarbons in the part of the formation comprises an atomic hydrogen weight percentage, when measured on a dry, ash-free basis, of greater than about 4.0 %; and

producing a mixture from the formation.

1609. (amended) The method of claim 1608, wherein the one or more ~~of the~~ heaters comprise at least two heaters, and wherein controlled superposition of heat from at least the two heaters pyrolyzes at least some hydrocarbons within the part of the formation.

1616. (amended) The method of claim 1608, further comprising pyrolyzing hydrocarbons within the part of the formation and controlling the heat such that an average heating rate of the part of the formation is less than about 1 °C per day ~~during~~ in a pyrolysis temperature range of about 270 °C to about 400 °C.

1617. (amended) The method of claim 1608, wherein providing heat from one or more of the heaters to at least the portion of the formation comprises:

heating a selected volume (V) of the hydrocarbon containing formation from one or more of the heaters, wherein the formation has an average heat capacity (C_v), and wherein the heating pyrolyzes at least some hydrocarbons within the selected volume of the formation; and

wherein heating energy/day (*Pwr*) provided to the selected volume is equal to or less than $h*V*C_v*\rho_B$, wherein ρ_B is formation bulk density, and wherein an average heating rate (h) of the selected volume is about 10 °C/day.

1619. (amended) The method of claim 1608, wherein allowing the heat to transfer to the part of the formation heats ~~providing heat from one or more of the heaters comprises heating~~ the part of the formation ~~such that~~ to increase a thermal conductivity of at least a portion of the part of the formation ~~is~~ to greater than about 0.5 W/(m °C).

1631. (amended) The method of claim 1608, wherein the produced mixture comprises a non-condensable component that does not condense at 25° C and one atmosphere absolute pressure, wherein the non-condensable component comprises molecular hydrogen, wherein the molecular hydrogen is greater than about 10 % by volume of the non-condensable component, and wherein the molecular hydrogen is less than about 80 % by volume of the non-condensable component.

1641. (amended) The method of claim 1608, wherein allowing the heat to transfer ~~comprises increasing~~ increases a permeability of a majority of the part of the formation to greater than about ~~100~~ 250 millidarcy.

1642. (amended) The method of claim 1608, wherein allowing the heat to transfer ~~comprises increasing~~ increases a permeability of a majority of the part of the formation such that the permeability of the majority of the part is substantially uniform.

1645. (amended) The method of claim 1608, further comprising providing heat from ~~three or more~~ heaters to at least a portion of the formation, wherein ~~three or more of~~ the heaters are located in the formation in a unit of heaters, and wherein the unit of heaters comprises a triangular pattern.

1646. (amended) The method of claim 1608, further comprising providing heat from ~~three or more~~ heaters to at least a portion of the formation, wherein ~~three or more of~~ the heaters are

located in the formation in a unit of heaters, wherein the unit of heaters comprises a triangular pattern, and wherein a plurality of the units are repeated over an area of the formation to form a repetitive pattern of units.

1647. (amended) A method of treating a hydrocarbon containing formation in situ, comprising:

providing heat from one or more heaters positioned in heater wells to at least a portion of the formation;

allowing the heat to transfer from one or more of the heaters to a part of the formation;

wherein at least some hydrocarbons within the part of the formation have an initial atomic hydrogen weight percentage of greater than about 4.0 %; and

producing a mixture from the formation.

1648. (amended) The method of claim 1647, wherein one or more of the heaters comprise at least two heaters, and wherein controlled superposition of heat from at least the two heaters pyrolyzes at least some hydrocarbons within the part of the formation ~~of the formation~~.

1654. (amended) The method of claim 1647, further comprising controlling a pressure and a temperature within at least a majority of the part of the formation ~~of the formation~~, wherein the pressure is controlled as a function of temperature, or the temperature is controlled as a function of pressure.

1655. (amended) The method of claim 1647, further comprising pyrolyzing hydrocarbons within the part of the formation, and controlling the heat such that an average heating rate of the part of the formation is less than about 1 °C per day ~~during~~ in a pyrolysis temperature range of about 270 °C to about 400 °C.

1656. (amended) The method of claim 1647, wherein providing heat from one or more of the heaters to at least the portion of the formation comprises:

heating a selected volume (V) of the hydrocarbon containing formation from one or more of the heaters, wherein the formation has an average heat capacity (C_v), and wherein the heating pyrolyzes at least some hydrocarbons within the selected volume of the formation; and

wherein heating energy/day (Pwr) provided to the selected volume is equal to or less than $h*V*C_v*\rho_B$, wherein ρ_B is formation bulk density, and wherein an average heating rate (h) of the selected volume is about 10 °C/day.

1658. (amended) The method of claim 1647, wherein allowing the heat to transfer to the part of the formation heats ~~providing heat from one or more of the heaters comprises heating~~ the part of the formation ~~such that~~ to increase a thermal conductivity of at least a portion of the part of the formation ~~is~~ to greater than about 0.5 W/(m °C).

1670. (amended) The method of claim 1647, wherein the produced mixture comprises a non-condensable component that does not condense at 25° C and one atmosphere absolute pressure, wherein the non-condensable component comprises molecular hydrogen, wherein the molecular hydrogen is greater than about 10 % by volume of the non-condensable component, and wherein the molecular hydrogen is less than about 80 % by volume of the non-condensable component.

1673. (amended) The method of claim 1647, further comprising controlling a pressure within at least a majority of the part of the formation ~~of the formation~~, wherein the controlled pressure is at least about 2.0 bar absolute.

1680. (amended) The method of claim 1647, wherein allowing the heat to transfer ~~comprises increasing~~ increases a permeability of a majority of the part of the formation to greater than about ~~100~~ 250 millidarcy.

1681. (amended) The method of claim 1647, wherein allowing the heat to transfer ~~comprises increasing~~ increases a permeability of a majority of the part of the formation such that the permeability of the majority of the part of the formation is substantially uniform.

1684. (amended) The method of claim 1647, further comprising providing heat from ~~three or more~~ heaters to at least a portion of the formation, wherein ~~three or more of~~ the heaters are located in the formation in a unit of heaters, and wherein the unit of heaters comprises a triangular pattern.

1685. (amended) The method of claim 1647, further comprising providing heat from ~~three or more~~ heaters to at least a portion of the formation, wherein ~~three or more of~~ the heaters are located in the formation in a unit of heaters, wherein the unit of heaters comprises a triangular pattern, and wherein a plurality of the units are repeated over an area of the formation to form a repetitive pattern of units.

5400. (amended) A method of treating a hydrocarbon containing formation in situ, comprising:

providing heat from one or more heaters positioned in heater wells to at least a portion of the formation;

allowing the heat to transfer from one or more of the heaters to a selected section of the formation;

wherein at least some hydrocarbons within the selected section have an initial atomic hydrogen weight percentage of greater than about 4.0 %; and

producing a mixture from the formation.

5402. (amended) The method of claim 5400, wherein the one or more heaters comprise at least two heaters, and wherein controlled superposition of heat from at least the two heaters pyrolyzes at least some hydrocarbons within the selected section.

5404. (amended) The method of claim 5400, wherein at least one of the one or more ~~of~~ heaters comprises a natural distributed combustor.

5406. (amended) The method of claim 5400, further comprising pyrolyzing hydrocarbons within the ~~selected section~~ part of the formation and controlling the heat such that an average

heating rate of the ~~selected section~~ part of the formation is less than about 1 °C per day within a pyrolysis temperature range of about 270 °C to about 400 °C.

5407. (amended) The method of claim 5400, wherein providing heat from the one or more heaters to at least the portion of the formation comprises:

heating a selected volume (V) of the hydrocarbon containing formation from one or more of the heaters, wherein the formation has an average heat capacity (C_v), and wherein the heating pyrolyzes at least some hydrocarbons within the selected volume of the formation; and

wherein heating energy/day (Pwr) provided to the selected volume is equal to or less than $h*V*C_v*\rho_B$, wherein ρ_B is formation bulk density, and wherein an average heating rate (h) of the selected volume is about 10 °C/day.

5412. (amended) The method of claim 5400, wherein at least about 20 ~~heat sources~~ heaters are disposed in the formation for each production well.